power, the inter-electrode potential difference required for performing entire planar resetting by setting the cholesteric liquid crystal in all the inter-pixel-positions to be in the planar state can be generated by switching the voltage values of GNDr and GNDc supplied to the row driver 53 and the column driver 52. The switching of the voltage values of GNDr and GNDc can be performed by using the switches 54 and 55, which are formed by, for example, FETs.

Here, the case of performing bicolor display has been described. However, it is obvious to apply the present invention to the case of performing multicolor display by a liquid crystal display device using cholesteric liquid crystal.

Since, in displaying information after entire resetting to white, a method similar to that in the liquid crystal display device of the related art which uses cholesteric liquid crystal is used, the breakout voltages required for the row driver 53 and the column driver 52 are determined by the inter-pixel-electrode voltage required for setting the cholesteric liquid crystal to the focal conic state. In other words, in the liquid crystal display device including the liquid crystal driving circuit 41 to which the present invention is applied, each breakout voltage required for the row driver 53 and the column driver 52 can be reduced to approximately half of that in the case of the related art.

Therefore, according to the liquid crystal display device including the liquid crystal driving circuit 41 to which the present invention is applied, the color of arbitrary pixels can be inverted from a specified wavelength color to black while suppressing a driver breakout voltage, thus realizing size reduction and cost reduction concerning the liquid crystal driving circuits for driving the cholesteric liquid crystal panel 1.

The above-described consecutive processing can be also performed by software. The software is installed from a recording medium to a computer in which programs constituting the software are built in dedicated hardware, or, for example, a multipurpose personal computer or the like in which, by installing various types of programs, various types of functions can be executed.

As shown in Fig. 9, this recording medium includes a package medium which is distributed for providing a program to a user separately for the computer, and which includes a magnetic disk 61 (including a flexible disk), an optical disk 62 (including a CD-ROM (Compact Disk-Read Only Memory) or a DVD (Digital Versatile Disk)), a magneto-optical disk 63 (including an MD (Mini-Disk) (trademark)), or a semiconductor memory 64, in which a program is recorded.

Industrial Applicability

CLAIMS

1. A display device having display means in which, by applying voltages to first electrodes and second electrodes, the state of cholesteric liquid crystal is changed to display information, the display device comprising:

first driving means for applying a voltage to the first electrodes;

second driving means for applying a voltage to the second electrodes; and

control means for controlling the operation of the first driving means and the second driving means, the voltage value of a first reference voltage supplied to the first driving means, and the voltage value of a second reference voltage supplied to the second driving means,

wherein, when the control means sets the cholesteric liquid crystal to a planar state, the control means controls the operation of the first driving means and the second driving means so that the first driving means applies the first reference voltage to the first electrodes and the second driving means applies the second reference voltage to the second electrodes, and controls the voltage values of the first reference voltage and the second reference voltage so that the cholesteric liquid crystal exhibits the planar state.

2. The display device according to claim 1, wherein:

the first driving means is supplied with a first driving voltage having a voltage value different from that of the first reference voltage;

the second driving means is supplied with a second driving voltage having a voltage value different from that of the first reference voltage; and

when the control means sets the cholesteric liquid crystal to a focal conic state, the control means controls the operation of the first driving means and the second driving means so that the first driving means applies the first driving voltage to the first electrodes and the second driving means applies the second driving voltage to the second electrodes.

3. The display device according to claim 1, further comprising:

first switching means for selectively switching the voltage value of the first reference voltage supplied to the first driving means between a first voltage value and zero volts; and

second switching means for selectively switching the voltage value of the second reference voltage supplied to the second driving means between a second voltage value and zero volts,

wherein, when the control means sets the cholesteric liquid crystal to the planar state, the control means

controls the operation of the first driving means and the second driving means so that the first driving means applies the first reference voltage to the first electrodes and the second driving means applies the second reference voltage to the second electrodes, and further controls the first switching means and the second switching means so that the voltage value of the first reference voltage supplied to the first driving means is set as the first voltage value and the voltage value of the second reference voltage supplied to the second driving means is set as the second voltage value.

4. The display device according to claim 1, wherein the display means has the cholesteric liquid crystal, which has a plurality of portions reflecting light components having different wavelength bands in the planar state.

5. A display method for a display device having a display unit which displays information with cholesteric liquid crystal by applying voltages to first electrodes and second electrodes, the display method including:

a first reference-voltage applying step of applying a first reference voltage to the first electrodes;

a second reference-voltage applying step of applying a second reference voltage to the second electrodes;

a first-reference-voltage control step of controlling the voltage value of the first reference voltage;

a second-reference-voltage control step of controlling the voltage value of the second reference voltage; and

a display control step of controlling the display of the information on the display unit by applying, to the first electrodes and the second electrodes, a first driving voltage and a second driving voltage which differ from the first reference voltage and the second reference voltage.

6. A liquid crystal driving circuit for driving liquid crystal display elements including cholesteric liquid crystal, the liquid crystal driving circuit comprising:

first driving means for applying a voltage to first electrodes of the liquid crystal display elements;

second driving means for applying a voltage to second electrodes of the liquid crystal display elements; and

control means for controlling the operation of the first driving means and the second driving means, the voltage value of a first reference voltage supplied to the first driving means, and the voltage value of a second reference voltage supplied to the second driving means,

wherein, when the control means sets the cholesteric liquid crystal to a planar state, the control means controls the operation of the first driving means and the second driving means so that the first driving means applies the first reference voltage to the first electrodes and the second driving means applies the second reference voltage to

the second electrodes, and controls the voltage values of the first reference voltage and the second reference voltage so that the cholesteric liquid crystal exhibits the planar state.

7. A liquid crystal driving method for a liquid crystal driving circuit which drives liquid crystal display elements including cholesteric liquid crystal by applying voltages to first electrodes and second electrodes, the liquid crystal driving method including:

a first reference-voltage applying step of applying a first reference voltage to the first electrodes;

a second reference-voltage applying step of applying a second reference voltage to the second electrodes;

a first-reference-voltage control step of controlling the voltage value of the first reference voltage;

a second-reference-voltage control step of controlling the voltage value of the second reference voltage; and

a driving-voltage-application control step of controlling application, to the first electrodes and the second electrodes, of a first driving voltage and a second driving voltage which differ from the first reference voltage and the second reference voltage.